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GAS ABSTRACTS

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1. GAS INDUSTRY

Alberta Gas

ALBERTA NATURAL GAS. *World Petroleum*, 25, 98-102 (1954) May.

A review of Alberta Natural Gas, the amount of reserves and their location, the proposed method of gathering gas for export, implications as to by-products, and plants needed to process the gas for transmission.

R. F. Bukacek

Education

Dotterweich, F. H. NATURAL GAS EDUCATION AND RESEARCH PROGRAMS EXPAND AT TEXAS A & I COLLOEGE. *Amer. Gas J.*, 180, 32, 33, 52 (1954) May.

A description of the educational program conducted at Texas A & I College for the natural gas industry. The present program includes undergraduate work, graduate work toward the degree Master of Science, sponsored research, the SGA short course in gas technology and the SGA management development program. The article describes this program in some detail and includes information on its initiation and sponsorship. R. F. Bukacek

Engineering Research

Morgen, R. A. SURVEY OF ENGINEERING COLLEGE NEEDS FOR BASIC RESEARCH IN THE ENGINEERING SCIENCES. *J. Eng. Educ.*, 44, 375-384 (1954) March.

This survey was undertaken with the view to determine the present status of graduate education and research in engineering schools, the potential now extant to perform the task of increasing the supply of engineers with advanced degrees, and to make a rough estimate of the minimum financial needs to meet these requirements. In brief it was concluded that an insufficient number of engineering colleges recognize their responsibility in regard to research, that more funds are needed for staff salaries, and that about 2700 additional graduate students could be educated with present facilities. R. F. Bukacek

Hotel Heating

HEATING A HOTEL. *Coal-Heat* 66, 19-33 (1954) May.

In 1952, the hotel industry with a gross income of $2.2 billion is said to be the seventh largest industry. These 29,650 hotels, of 1,600,000 guest rooms, spent $127 million for heat, power and light, $43 million for laundry. Details of hotel operation, motels, heating, water, laundry and restaurants, fuels, boiler equipment and performance are discussed. O. P. Brysch

Mechanized Documentation

Dyson, G. M. STUDIES IN CHEMICAL DOCUMENTATION. PART III.—MECHANIZED DOCUMENTATION. *Chem. and Ind.* (British) 440-449 (1954) April 17.

Each year there are some 72,000 articles of interest to the chemical industry that are abstracted. However, when a comprehensive literature survey on any topic is undertaken it is still possible to overlook many articles of interest simply through the inability of an abstract to present details of procedure, and also due to the difficulty of locating all the articles which deal with the topic selected. A system of nomenclature which is capable of representing the chemical structure has been partially standardized, and a method of reducing the resulting non-ambiguous serial of numbers and letters to a punched card has been devised. In this manner it would be conceivable to punch cards representing a complete index of articles, techniques, and properties relative to each substance, and have a completely mechanical method of locating information. A brief discussion of the methods of nomenclature and the mechanical details of the card punching and sorting, as well as a demonstration of the enormous scope of possibilities opened by such a technique are presented. B. E. Eakin

Operations Research

Morse, P. M. OPERATIONS RESEARCH. *Mech. Eng.*, 76, 231-235 (1954) March.

Operations research is the application of research techniques to the study of the operations of war and peace. It examines what occurs when a team of men or machines does the job assigned to it. It is an activity; a pattern of operations, susceptible of being related to other

diverse activities. Its applications encompass such unrelated matters as determining time of waiting in line in a restaurant; fixing the interrelation between sales fluctuations, size of inventories, and production scheduling; or developing a pattern of search operations for an enemy submarine or aircraft. In operations research there is an opportunity for scientists and engineers to help in administrative problems, not by becoming the administrator, but by providing the administrator with quantitative understanding of aspects of his operational problems, so that he can reach a wise decision, fully conscious of the implications of his choice.

Author's Abstract

2. APPLIANCES

Burners

Ray, W. R. ROTARY GAS BURNER. U. S. 2,675,868 (1954) April 20.

Ward, M. E. (assigned to Surface Combustion Corp.) GAS MIXER. U. S. 2,675,869 (1954) April 20.

Controls and Ignition

Perl, R. L. (assigned to The Tappan Stove Co.) AUTOMATIC IGNITION MECHANISM FOR PLURAL GAS BURNERS. U. S. 2,675,870 (1954) April 20.

Schell, P. (assigned to Penn Controls, Inc.) GAS MODULATING VALVE CONTROL. U. S. 2,675,965 (1954) April 20.

Thornbery, J. H. (assigned to Milwaukee Gas Specialty Co.) BURNER CONTROL VALVE. U. S. 2,676,757 (1954) April 27.

Wittmann, R. A. (assigned to Hardwick Stove Co.) GAS FUELED PILOT ASSEMBLY AND THERMAL CONTROL ELEMENT. U. S. 2,677,418 (1954) May 4.

Cooker

Van Helden G. WALL SUPPORTED GAS COOKER. U. S. 2,675,796 (1954) April 20.

Heat Pump

Montagnon, P. E., and Ruckley, A. L. THE FESTIVAL HALL HEAT PUMP. *J. Inst. Fuel* (British), 27, 170-192 (1954) April.

This paper gives an account of the heat pump installed by the Ministry of Fuel and Power at the Royal Festival Hall through the stages of developing the various components and the installation and operation of the plant. The prime movers for the heat pump were Merlin aircraft engines converted to run on town gas and arranged to drive centrifugal compressors. The development of the engines' compressors and the high-speed rotary sealing units proved to be the most difficult task. The output of the plant was some 9 million B.Th.U./hr., which proved to be vastly in excess of the average requirements of the Festival Hall, in spite of the original estimate that the peak load on the hall would be over 25 million B.Th.U./hr. An analysis of the performance of the plant has led to the suggestion that a plant of this type might be installed for a cost of some £52,500 and that it would burn town gas at an effective efficiency on peak load of about 1.25. A favourable overall economic picture for such an installation can be made when summer-time refrigeration is a desirable feature of the building concerned, in which case it is suggested that the heat pump should be designed to have an output based on the refrigerating load rather than the heating load. Authors' Abstract

Oil Gas Substitutability

Searight, E. F., Boyd, J. R., Parker, R. and Linden, H. R. APPLIANCE TESTS ON THE SUBSTITUTABILITY OF HIGH-BTU OIL GAS FOR NATURAL GAS. Paper No. CEP-54-9 Am. Gas Assoc., Operating Section, Pittsburgh, Pa. (1954) May.

This paper presents the results of a study of the performance of typical scrubbed high-Btu oil gases with true (inert-free) heating values in the 900-1500 Btu/SCF range when substituted for high-methane natural gas on a group of seven critical burners, and a group of thirteen critical and contemporary appliances. This substitution was made at two test conditions: 1) dilution with a synthetic blast blowrun gas (20% carbon dioxide-80% nitrogen) to approximately 1000 Btu/SCF, the heating value of the base gas; and 2) dilution with this inert gas to heating values and specific gravities that would maintain rated burner heat inputs. Critical burner tests with oil gases modified, when necessary, to constant heat input equal to that of the base natural gases showed that: 1) At

moderately soft (—2) flame adjustments where the limiting factor was yellow-tipping, the substitutabilities decreased rapidly as true oil gas heating values increased. This decrease in substitutability followed the increase in yellow-tipping components (ethylene and higher unsaturates). 2) At moderately hard (+2) flame adjustments, where the limiting factor was flashback on rapid turndown, the flashback tendency increased as the true oil gas heating value increased. This increased flashback tendency may have been caused by a shift in the position of the characteristic flashback curve of the oil gas as the hydrogen and paraffin concentrations were reduced and the unsaturates concentrations increased. The appliance data obtained for scrubbed oil gases modified, when necessary, with inerts to heating values and specific gravities resulting in rated heat inputs to all burners, showed that: 1) At moderately soft (—2) flame adjustments, and at normal (0) flame adjustments, where the limiting factor was yellow-tipping, there was good agreement between the critical burner and critical appliance tests. At these adjustments the critical burners and critical appliances had approximately the same minimum primary aerations. 2) At hard (+2) flame adjustments, where the limiting factor was flashback at rapid turndown, the degree of substitutability was considerably greater on the appliances than on the critical burners. For the units considered in the correlations, the maximum primary aeration of the critical burners mounted in the open as determined on the base natural gas was 87%, while the maximum primary aeration of the burners in the critical appliances was 68%. This increased flashback tendency of the critical burners thus appeared to be the normal increase in flashback with increased primary aerations.

Authors' Abstract

3. COMBUSTION AND INDUSTRIAL FURNACES

Acetylene Flames

Prout, W. E. and Anderson, R. C. FLAME PROPAGATION IN THE SELF-COMBUSTION OF ACETYLENE. *Fuel* (British) 33, 125-133 (1954) April.

A study on the self-combustion of acetylene gas. The gas was introduced into a tube and ignited with an electric igniter. The flames were spheroid in shape and were trailed by a dense cloud of carbon. The light emitted was a deep orange in color, characteristic of incandescent carbon. The flame propagation was recorded on both moving pictures and occasional single photographs. The tube pressure was also recorded. The investigation was carried out on tubes of varying diameter and length and at varying pressures.

M. Quinn

Coal Burning Turbine

Yellott, J. I. (assigned to Bituminous Coal Research, Inc.) PULVERIZED FUEL GAS TURBINE POWER PLANT. U. S. 2,675,676 (1954) April 20.

The patent relates to the development of a coal burning gas turbine locomotive by Bituminous Coal Research, Inc. It is concerned specifically with "improvements in coal-burning gas turbine power plants wherein all storage of fuel and ash is accomplished at atmospheric pressure and all operations, including fuel preparation, other than combustion and ash separation, are likewise conducted at atmospheric pressure." Particular attention is given to an improved rotary coal transfer pump which transports pulverized coal from an atmospheric pressure zone to a high-pressure zone for combustion. An ash separation system with continuous blowdown is also discussed in detail.

P. R. Trumpler

Coke Burner

Walker, J. N. APPLYING A DOWN-JET COKE BURNER TO A GAS-FIRED BOILER. *Gas World* (British), 89, Suppl. 84-85 (1954) April 17.

The conversion of a gas-fired boiler to a down-jet coke burning unit is discussed with a summary of the results of operation. Fuel in the down-jet is gravity fed from a sealed storage hopper forming an inclined bed. Here a jet of air impinges and penetrates the bed, with combustion taking place below the bed surface. Combustion rates are controlled by a butterfly valve in the air line. The unit has operated successfully and has indicated higher efficiencies than obtained with underfired coal stokers under similar conditions.

E. J. Pyrcioch

Heat Treating

Copeland, A. H., Jr. THE ANNEALING OF COPPER AND BRAS ALLOYS. *Ind. Heating*, 21, 444-46, 48, 50-52, 54, 56 (1954) March.

This article was originally presented as a lecture at the Industrial Gas School in Detroit. The author describes a number of rolling, extrusion, annealing and preheating operations in detail and includes data on the temperature level and fuel consumption for each operation. The use of bright annealing furnaces, both direct-fired and radiant-tube types using DX atmospheres, is taken up in detail and the great saving over older methods requiring pickling, neutralizing and storage under water is brought out. Since the metallurgical result of each operation is covered this article should provide good reference material for application engineers. R. T. Ellington

Holman, G. P. FORGING AND HOT FORMING: I. *Ind. Heating*, 21, 474, 76, 78, 80, 616, 18 (1954) March.

This article (given as a lecture at the Detroit Industrial Gas School) provides very good descriptive information on the modern methods of forging: hammers, presses and upsetters, and is worth the time of anyone concerned with applications. R. T. Ellington

Industrial Heating

CONTROLLED HEATING FOR AC (ASPHALT CONCRETE) PLANTS. *Ind. Heating*, 21, 466, 67, 68, 70 (1954) March.

This article describes the use of gas-fired vertical tubular heaters for heating a heat-transfer oil which is circulated through asphalt storage tanks to maintain the asphalt at a controlled temperature of up to 300° F. The hot asphalt is combined with dried aggregate to give the widely used paving mix. The article neglects to discuss the direct firing of aggregate driers which can be one of the largest loads in plants of this type. These plants represent ideal loads for gas companies since they are forced to shut down during periods of low temperature. R. T. Ellington

CONTROLLED RUG DRYING WITH GAS-FIRED AIR HEATER. *Ind. Heating*, 21, 535, 36, 38, 40-41 (1954) March.

Accurate control of temperature in the drying room is the most difficult operation in commercial rug cleaning. Low temperature air (120° F.) high circulation rates and long drying times are necessary to give a brighter product free from streaks. This installation uses a premix direct-fired, push-through scroll type air heater with complete safety for the direct gas-fired application, compared to the less than 70% round-the-loop fuel efficiency for steam-fired heaters. Also noted are the advantages of rapid heatup, low priced cost and precise temperature control for the installation. R. T. Ellington

MINERAL WOOL MANUFACTURE BY JET BLAST OF LQIUID SLAG. *Ind. Heating*, 21, 568-69 (1954) March.

A commercial process at small investment is described for using a gas-fired reverberatory furnace to melt slag and "fluff" it to mineral wool. About 30 tons per day of combined smelter and chemical plant slag are melted, with about 15 MCF gas per hour, and passed through orifices to form quarter-inch streams which are fluffed by 90 psi steam jets. Hot flue products from the melting furnace pass through an 80 hp exhaust heat boiler which supplies all the processing steam. R. T. Ellington

4. CARBONIZATION AND GASIFICATION

Carrier-Gas Coking

Gaskill, M. S. PROCESSING OF COAL. *Gas J.* (British), 278, 109-14, 19, 20 (1954) April 14; *Coke and Gas* (British) 16, 153-8 (1954) April; *Gas World* (British) 139, 1322-29 (1954) May 15.

Various methods for the processing of coal, as distinct from its direct use as a fuel, are reviewed. Gasification and low temperature carbonization are treated briefly while a more detailed presentation of high temperature carbonization is given along with a proposed method whereby control of the carbonization process is attained by internal heating of the coal charge. For this operation a continuous vertical retort is used with a hot carrier gas for trans-

fering heat from the base of the retort through the coal charge to the top. The carrier gas may be coal gas, water gas or producer gas. Results of tests (at an average combustion chamber temperature of 1,300° C. in a 50-inch retort) for several coals with these carrier gases are presented. Advantages cited include increased thermal output and coke production. (See also *Gas Abs.* 10, 103 (1954) June).

E. J. Pyrcioch

French Coke Research

Cheradame, R. STUDIES IN COKE FORMATION. *Coke and Gas* (British), 16, 143-49 (1954) April.

The Centre d'Etudes et Recherches des Charbonnages de France (CERCHAR) for several years has concentrated its efforts toward production of blast furnace coke suitable by Micum drum specifications from French (Lorraine or Saar) "gras" or weakly caking bituminous coals. Three processes, each involving careful blending of several components, have been developed to an industrial scale" 1) Thionville, using up to 67% "gras" by eliminating fines and retaining the 7 to 15 mm size (40 to 50% "gras" permitted use of straight plant coke in furnaces): 2) Carling; using 62-72% Lorraine of 0.5 to 3 mm size by stamping charges (with 7 to 12% fine coke dust) to 62.5 lb. and coking at high speed: 3) Burstlein-Sovaco; using 60% Lorraine coal by selective screening to obtain granular vitrain, and repulverizng oversize to uniformly fine durain and clarain constituents. In addition, experimental oven tests using up to 10% of semi-coke dust from non-coking coals, with as much as 65% "gras" coals (remainder Ruhr coking coal), gave quite satisfactory furnace coke.

O. P. Brysch

Gasification

Dressler, R. G., Batchelder, H. R., Tenney, R. F., Wenzell, L. P., Jr. and Hirst, L. L. OPERATION OF A POWDERED-COAL GASIFIER AT LOUISIANA, MO. U. S. Bur. Mines Rep. Invest. 5038 (1954) April.

Gasification results are presented for a Koppers pulverized coal gasifier operated with oxygen-steam mixtures at atmospheric pressure, with gasification temperatures in the range 2000° F.-2400° F. and at coal feed rates of approximately 2000 lb/hr. Tabulated data for some 22 runs varying from several hours to 11 days in length show synthesis gas heating values of 240 -265 Btu SCF obtained under the following range of the principal operating variables: oxygen-coal ratio, 7.0-11.0 SCF/lb dry coal; steam-coal ratio, 0.8 - 1.2 lb/lb dry coal and 1400° - 2000° F. superheated steam temperature. Steam decompositions ranged from 0.1 to 0.2 lb/lb dry coal, carbon conversions attained a maximum of 85 - 89% at the highest oxygen-coal ratios investigated, with corresponding maximum thermal efficiencies of 60 - 65% based on the heating value of the coal fed. This coal analyzed approximately 90% passing a 200 mesh sieve and had a net heating value of 12,500 - 13,000 Btu/lb dry. The gasifier, which consisted of a horizontal cylindrical vessel insulated to internal dimensions of 7.0 ft T. D. by 10 ft long, with opposed coal burning nozzles provided at each end, presented a principal operating difficulty in the accumulation of fused ash and unreacted carbon causing restriction of the ash collecting legs.

C. G. von Fredersdorff

Garbo, P. W. (assigned to Hydrocarbon Research, Inc.) PROCESS FOR THE PREPARATION OF CARBON MONOXIDE AND HYDROGEN. U. S. 2,674,524, 2,674,525 (1954) April 6.

The patents refer to a thermofor-type process for the gasification of carbonaceous material, involving the use of inert heat transfer solids mixed with coal or like substances, alternately heated in the regenerator and cooled in the gas generator sections of the unit.

C. G. von Fredersdorff

Loon, W., van (assigned to Directie Staatsmijnen Limburg) PROCESS AND APPARATUS FOR THE GASIFICATION OF FINE-GRAINED CARBONACEOUS SUBSTANCES. U. S. 2,677,603 (1954) May 4.

The patent refers to a combination system of pulverized solids gasification involving an entrainment reactor operating with partial combustion in oxygen followed by a fluidized reactor operating with oxygen and steam.

C. G. von Fredersdorff

Smith, R. N., Pierce, C. and Joel, C. D. THE LOW TEMPERATURE REACTION OF WA-

TER WITH CARBON. *J. Phys. Chem.*, 58, 298-302 (1954) April.

Results of the low temperature experimental work on the C-H_2O reaction show that two types of oxygen complexes, one for CO and another for CO_2 formation, can be postulated. Furthermore, the presence on the surface of sulfur or oxygen impurities greatly enhanced this reaction. S. Mori

Totzek, F. SYNTHESIS GAS FROM THE KOPPERS-TOTZEK GASIFIER. *Chem. Eng. Progress*, 50, 182-187 (1954) April.

Operating results and some photographs are presented of a commercial-size Koppers powdered coal gasification plant located in Oulu, Finland at the Typpi Oy Company, producers of synthetic ammonia. The plant, set in operation in July, 1952, consumes approximately 110 tons coal dust and 1,902 MCF 98.5% oxygen per day, yielding a 274 Btu synthesis gas of 0.67 H_2/CO ratio and requiring 39.0 lb dry coal dust, 365 SCF oxygen, 21.3 lb steam and 17.8 gal cooling water per MCF of CO + H_2 produced. The gasifiers, of which three identical were constructed, consist of horizontal refractory-lined cylindrical chambers having opposed jet firing of pulverized coal mixed with steam and oxygen. Each unit is provided with a rotary, water-cooled ash scraper to remove slag from the gasifier floor and to discharge it into a wet ash hopper. Radiation-type and convection-type waste heat boilers at the gasifier exit generate most of the required process steam. Synthesis gas cleaning is accomplished by a series of water scrubbing towers augmented by a centrifugal disintegrator.

C. G. von Fredersdorff

Wagener, D. DIE VERFAHREN ZUR VERGASUNG FESTER BRENNSTOFFE. (PROCESSES FOR GASIFICATION OF SOLID FUELS.) *Erdoel und Kohle* (German) 7, 219-226 (1954) April.

A summary is presented of fixed bed, fluid bed and entrainment techniques for the gasification of solid fuels at atmospheric and superatmospheric pressures. A comparison is included of the various reactors required for carrying out the gasification processes.

C. G. von Fredersdorff

Hydrocarbon Gasification

Linden, H. R., Guyer, J. J., Pettyjohn, E. S. PRODUCTION OF NATURAL GAS SUBSTITUTES BY PRESSURE HYDROGASIFICATION OF OILS. Inst. Gas Technology Interim Report (1954) Jan.; Paper No. CEP-54-7 Amer. Gas Assoc. Opertg. Section, Pittsburgh, Pa. (1954) May.

An evaluation of the results of a laboratory study of the pressure hydrogasification of three typical gas-making oils. Tests were made at gasification pressures of 1 to 5 atmospheres (0 to 60 psig), cracking temperatures of 1350° to 1550° F., residence times of 2.5 to 10.5 seconds, and hydrogen-oil feed ratios of 0 to 90 SCF/gallon. Effects of hydrogen-oil feed ratio, cracking temperature, gasification pressure, and residence time on pressure hydrogasification results and a substitutability of high-Btu oil gas for natural gas are discussed and illustrated with graphs. J. J. Guyer

Shultz, E. B., Jr., Guyer, J. J. and Linden, H. R. PRODUCTION OF HIGH BTU OIL GASES FROM CRUDE SHALE OILS. Inst. Gas Technology Interim Report (Project No. PB-8-6) (1954) February.

This Interim Report presents experimental data obtained in the thermal gasification of two typical crude shale oils using a 2½ inch I.D. externally heated laboratory cracking tube over a range of cracking conditions resulting in the production of gases with heating values from 900 to 1500 Btu/SCF. Runs were made at atmospheric pressure, using steam for atomization and partial pressure control, at cracking temperatures from 1400 to 1550° F., and residence times from 2 to 4½ seconds. The effects of severity of cracking on the Btu recoveries in the form of stable product gas and on the yields and compositions of the gaseous and nongaseous products are outlined in graphical form, and the gasification results for crude shale oils compared with similar data obtained for typical distillate and residual petroleum oils in earlier studies. The true (inert-free) product gas heating value is used to define the severity of cracking as determined by cracking temperature and residence time. Data on the substitutability of scrubbed shale oil gases after dilution

with inerts to give rated heat inputs on critical appliance burners adjusted for high methane natural gas are presented. These data are correlated with the inert-free product gas heating value at various primary air adjustments and are compared with equivalent results for high Btu oil gases. Authors' Abstract

Pettyjohn, E. S., Linden, H. R. and Bair, W. G. PRODUCING NATURAL GAS SUBSTITUTES Paper No. CEP-54-4 Amer. Gas Assoc. Opertg. Section, Pittsburgh, Pa. (1954) May; *Gas Age*, **113**, 19-26 (1954) May 20; *Gas*, **30**, 68-70 (1954) May; *Canad. Gas J.* **47**, 36-38 (1954) June.

Pressure hydrogasification of gasolines, naphthas, and kerosenes in a tube furnace was found to offer a means for the continuous production of high Btu gas completely substitutable or interchangeable for natural gas. Data based on pilot plant operation at 50 to 80 gal/hr and at 60 to 100 SCF of feed hydrogen/gal demonstrated that 930 to 1100 Btu/SCF gases consisting primarily of paraffins and hydrogen can be produced without the formation of significant amounts of tar, pitch or coke at 70 psia reaction pressure, 1370 to 1400° F maximum reaction temperature and three to five seconds residence time after suitable vaporization of the feed hydrocarbon and preheating of the feed hydrocarbon-hydrogen mixture. Complete conversion to gas was obtained with natural gasolines and conversions of over 82 weight percent maintained for the higher molecular weight feeds within the limits of product gas heating values and operating conditions stated. The non-gaseous products from these higher molecular weight feeds were primarily aromatics in the gasoline boiling range. The original pilot unit has been converted to operate as an integral hydrogasification plant. A combined catalytic cracking and hydrogasification furnace is expected to give optimum operating efficiency since the hydrogasification heat requirements can be met with the waste heat from the high-temperature catalytic cracking step. If hydrogen is to be produced by catalytic cracking of natural gas, seven MCF of 1000 Btu/SCF natural gas substitute could be produced per MCF of natural gas. If no natural gas is available, hydrogen can be produced from propane, butane or gasoline with some attendant reduction of catalytic cracking capacity and a corresponding increase in the investment cost. Hydrogen will be produced at pressures of 70-90 psig since this eliminates the necessity for recompression before introduction into the hydrogasification section. Equipment for conversion of carbon monoxide to hydrogen and carbon dioxide by the catalytic water-gas shift reaction, and removal of the carbon dioxide by ethanolamine scrubbing, are included in the redesigned unit. H. R. Linden

Methanation

Wainwright, H. W., Egleson, G. C., and Brock, C. M. LABORATORY-SCALE INVESTIGATION OF CATALYTIC CONVERSION OF SYNTHESIS GAS TO METHANE. U. S. Bur. Mines Rep. Invest. 5046 (1954) April.

Operating results are presented for the production of a 900-960 Btu gas through the catalytic methanation of a synthetic Lurgi gas, using a 30 cc laboratory-scale fixed bed reactor. The unit was operated in the temperature range 300°-400° C. at a fresh feed space-velocity of 2000 SCF/hr/CF catalyst, at 300 psig and with a 12:1 gas recycle ratio. The recycled product gas was saturated with 18 to 20% steam before admission to the catalyst. The catalyst consisted of an aluminum-manganese-promoted nickel on china clay prepared by precipitating the metal salts with potassium carbonate in the presence of China clay. Five extended duration tests with varying COS concentrations were conducted at the above conditions, yielding 900-960 Btu gases over a maximum period of 44 days when employing synthesis gas containing 0.04 gr S/CCF. The catalyst activity decreased with increasing sulfur concentration in the synthesis gas, demonstrating an operable period of 18 days with 0.12 gr S/CCF, 9 days with 0.19 gr S/CCF and 2 days with 1.53 gr S/CCF. A linear relationship appeared to exist between the sulfur content of the synthesis gas and the length of successful methanation period during which the conversion of $CO + H_2$ reached 97% and above. The catalyst decreased in activity in all tests after absorbing approximately 0.0058 gram sulfur/gram nickel. Re-

generation of the catalyst within 90% of its original activity was achieved by air oxidation at 900° C and atmospheric pressure. During the tests it was also demonstrated that startup after a shutdown period had a negligible effect on catalyst activity. C. G. von Fredersdorff

Oil Coking

Pettyjohn, E. S. (assigned to Institute of Gas Technology) HYDROCARBON COKING APPARATUS. U. S. 2,676,913 (1954) April 27.

Residual oils are thermally cracked in liquid form to produce coke and high heating value fuel gas, by treating at 1400° F. to 1800° F. on the floor of a rectangular refractory coking chamber heated by a porous tubular, gas-fired radiant burner located near the roof of the chamber. Heat is recovered by conducting the burner gases through floor channels, where combustion air is preheated. Carbon deposited from vapor-phase cracking on the radiant tube burner may be removed at intervals or continuously by forcing flue or fuel gas from within through the porous tube-wall. O. P. Brysch

Panindco Process

Loison, R. and Gautier, H. ESSAIS DE GAZEFICATION DE CHARBON PULVERULENT PAR LE PROCEDE PANINDCO. (STUDIES OF GASIFICATION OF PULVERIZED COAL BY THE PANINDCO PROCESS.) Charbonnages de France, Note Technique 3/54 (32 pp.) (1954) March.

The Panindco pulverized-coal gasification process consists of a vertical downflow generator operating at essentially atmospheric pressure, and has provision for superheating reactant steam and oxygen and for recycling unreacted carbon. During 1953 the revised pilot unit at Rouen, France, was operated at essentially non-slagging conditions in one-month campaigns on two French coals using air-steam and oxygen-air-steam mixtures, with lignite, sub-bituminous and bituminous coal as generator fuel. With oxygen enriched air-steam gasification a water-gas analyzing approximately 20% CO_2, 25% CO, 35% H_2, 0.5% CH_4 and 19.5% N_2 was obtained, requiring 300-350 SCF total oxygen per MCF CO + H_2 generated. Operating results are tabulated. C. G. von Fredersdorff

Reforming

Bailey, B. E. (assigned to Standard Oil Development Co.) PREPARATION OF SYNTHESIS GAS. U. S. 2,676,156 (1954) April 20.

Radiant heat is used in the thermal reforming of methane or natural gas to produce synthesis gas. E. J. Pyrcioch

Mayland, B. J., Comley, E. A. and Reynolds, J. C. AMMONIA SYNTHESIS GAS. *Chem. Eng. Progress*, **50**, 177-81 (1954) April.

The conventional process of manufacturing ammonia synthesis gas from natural gas by primary and secondary reforming at low pressure may be improved by three modifications: 1) operation at elevated pressure; 2) partial oxidation with air at low pressure; and 3) partial oxidation with air at elevated pressure. Basic steps, common to all four processes, for the preparation and purification of the synthesis gas are described in some detail and illustrated with flow diagrams. Major emphasis is laid on the economic evaluation of these improved methods as compared with the conventional process. S. Hu

5. NATURAL GAS AND NATURAL GAS CONDENSATES

Analytical Correlations

Zapffe, F. NATURAL GAS CORRELATIONS. *Petroleum Refiner*, 33, 142-149 (1954) April.

Correlations have been developed by which a rapid check can be made of the results of a complete gas analysis consisting of heating value, specific gravity, Orsat analysis, and fractional analysis. They can also be used to calculate the quantity of non-combustible or inert gases by means of the determined heating value and specific gravity when the Orsat analysis is not made. D. M. Mason

Calorific Control

Farmer, G. C. GAS CALORIFIC VALUE CONTROL (Part 1). *Gas J.* (British), 278, 241-243 (1954) April 28.

Accurate mixture control is discussed. The operation of proportional, floating, and derivative controllers are outlined, and the various systems discussed. B. E. Eakin

Compression

NAPOLEONVILLE: STATION OF FIRSTS. *Petroleum Eng.*, 26, D-35, 38, 40, 43, 44, 46 (1954) April.

The new station, put into operation recently, is on UGPL'S 30-in. main line, completed in 1952, which transports gas from offshore wells in the Gulf of Mexico and other South Louisiana fields to Kosciusko, Mississippi. Besides marking United's initial use of turbine energy for compression of gas, it is the first centrifugal station of any type in the system. The other 33 active stations all have reciprocating, or piston type, engines. The turbine is a 5700-hp, two-shaft machine fueled by natural gas from the pipe line. The compressor rotates at speeds up to 5500 rpm and is designed to handle as much as 800,000,000 cu ft of gas in a day's time.

Author's Abstract

Exploration

Taylor, W. L. GAS IS PRINCIPAL TARGET OF DRILL BIT. *Oil Gas J.*, 52, 168-70, 72 (1954) April 19.

The geology of the huge area located in northeastern Utah and northwestern Colorado, the Uinta basin, is presented in some detail. The structures appear to be favorable for the formation of oil and gas deposits. However, in addition to the "normal" difficulties of locating formations of sufficient porosity, permeability, and thickness for commercial quantities of hydrocarbons to be present, the area is also vexed with the occurrence of high percentages of carbon-dioxide and nitrogen in the gas that has been found. Nevertheless, it is predicted that large reserves will be proved in the area.

B. E. Eakin

Gas Dessicant

Getty, R. J., Lamb, C. E., and Montgomery, W. C. A NEW DESICCANT FOR DRYING NATURAL GAS. Proc. Gas Hydrate Control Conference, Univ. Oklahoma, 43-55 (1953) May 5-6.

A description of comparative field test work on activated Alumina H-151, a new dessicant believed to have superior properties.

R. F. Bukacek

Gas Injection

Justus, J. B., Cassingham, R. W., Blomberg, C. R. and Ashby, W. H. PRESSURE MAINTENANCE BY GAS INJECTION IN THE BROOKHAVEN FIELD, MISSISSIPPI. *J. Petroleum Techn.*, 6, 43-53 (1954) April.

The Brookhaven field is one of several Basal Tuscaloosa reservoirs located in south-central Mississippi. It is a sandstone reservoir, of erratic deposition and with several faults, having an approximate subsea depth of 9,800 ft. A large variation in permeability exists with a weighted average being 256 md. Estimated average interstitial water saturation is 45 per cent. The undersaturated reservoir fluid exhibits marked differences in physical properties with measured saturation pressures ranging from 733 to 2,255 psi. Early rapid decline in reservoir pressure caused the operating interests to unitize the field and initiate a program of pressure maintenance by gas injection. At the time gas injection was commenced, the reservoir pressure had fallen to nearly half of the original pressure with only 4.5 per cent of the original oil in place produced. The reservoir pressure has since been maintained at approximately 2,750 psig, and cumulative production to date is 17 per cent of original oil in place. An analysis of field performance during gas injection is presented in detail. The program of pressure maintenance by gas injection is considered to be a success, since the expected ultimate recovery has been increased and the current production rate is in excess of 2 per cent of original oil in place per year. Performance has been better, anticipated ultimate recovery is larger, and total production costs are lower than for a similar Basal Tuscaloosa reservoir nearby, even though that field appears to have a more effective natural water drive.

Authors' Abstract

Gas Loads

Robison, D. J. HOW TO DISPATCH INTERRUPTIBLE LOADS. Gas Age, 113, 44-47, 70, 71 (1954) April 22.

Maintaining an extensive integrated transmission and distribution system operating at a high load factor (60 to 100%) the year round is outlined. Careful placement of dispatchers and the

use of telemetric pressure and flow recorders, coupled with dual weather reports and forecasts, have provided a sufficiently flexible system to handle wide variations in the firm gas load. Some of the requirements of a good dispatcher are discussed. B. E. Eakin

Glycol-Water-Gas System

Townsend, F. M. VAPOR-LIQUID EQUILIBRIUM DATA FOR DIETHYLENE- AND TRIETHYLENE GLYCOL- WATER-NATURAL GAS SYSTEMS. Proc. Gas Hydrate Control Conference, Univ. Oklahoma, 57-77 (1953) May 5-6.

Experimental vapor-liquid equilibrium data for several glycols with water and natural gas are presented with a theoretical analysis and a description of equipment used. R. F. Bukacek

Hydrate Formation

Jacoby, R. H. VAPOR-LIQUID EQUILIBRIUM DATA FOR THE USE OF METHANOL IN PREVENTING GAS HYDRATES. Proc. Gas Hydrate Control Conference, Univ. Oklahoma, 24-41 (1953) May 5-6.

Vapor-liquid-hydrate data for the use of methanol to prevent hydrate formation is presented. The data given represent the extrapolation of literature data with some experimental hydrate decomposition temperature data confirming the extrapolation. R. F. Bukacek

Scauzillo, F. R., Baker, O. and Swerdloff, W. HYDRATE FORMATION IN TWO-PHASE HYDROCARBON SYSTEMS. Proc. Gas Hydrate Control Conference, Univ. Oklahoma, 1-15 (1953) May 5-6.

Experimental data on hydrate formation condition are presented for three mixtures of a 0.595-gravity natural gas and a high-stage separator oil recombined at total gas/oil ratios of 9270, 4483, and 1000 standard cubic feet of gas per barrel of stock tank oil. Data were obtained in the presence of excess field brine and also in the presence of excess distilled water. Additional experimental data are presented for a 0.594-gravity residue gas and for a 0.698-gravity casinghead gas and for mixtures of residue gas with absorption oil. R. F. Bukacek

H_2S Removal

Gollmar, H. A. (assigned to Koppers Co., Inc.) GAS PURIFICATION PROCESS. U. S. 2,675,-296 (1954) April 13.

The invention relates to the liquid purification of coke-oven gas by a process in which the gas is scrubbed with an aqueous absorbent which is regenerated by heating under subatmospheric pressure. D. M. Mason

Wenzell, L. P., Jr., Dressler, R. G., and Batchelder, H R. PLANT PURIFICATION OF SYNTHESIS GAS. *Ind. Eng. Chem.*, **46**, 858-866 (1954) May.

Experience with diethanolamine, iron oxide, active carbon, and soda-iron processes for purification of synthesis gas at the Bur. of Mines Gas Synthesis Demonstration Plant at Louisiana, Mo. is described. D. M. Mason

Increased Storage

STORAGE UP 35 PERCENT OVER 1952. *Amer. Gas Assoc. Monthly*, **36**, 13-14 (1954) April; *Gas Age*, **113** 39-41 (1954) April 22.

The ultimate capacity of existing storage pools increased from 1.29 trillion cubic feet in 1952, to 1.74 trillion cubic feet in 1953. A summary of pertinent data for 1951-1953 is included. A set of terms and definitions used in underground gas storage operations are also presented in an attempt to clarify and standardize the nomenclature of this phase of the gas industry. B. E. Eakin

Metering Error

Baird, R. C. EFFECTS OF PULSATION ON ORIFICE METERING. *Instruments and Automation*, **27**, 629-631 (1954) April.

This article presents mathematical methods for calculating orifice metering error due to pulsation and a discussion of the problem. It is concluded that pulsation elimination is the best approach to elimination of meter error. R. F. Bukacek

Kehoe, W. R. ORIFICE METER ACCURACY. *Petroleum Refiner*, **33**, 118-121 (1954) April.

A discussion of orifice metering, sources of trouble, and proper practices. R. F. Bukacek

Pipe Line Cleaning

McClure, C. HOW TO CLEAN AND TEST GAS LINES. *Gas Age*, 113, 36-38, 76, 79 (1954) April 8.

Recommendations are given in considerable detail for the internal cleaning of pipelines, where such cleaning requires the shutdown and cutting of the line. The use of water and detergent in cleaning is recommended with information to assist the person supervising the cleaning operation. R. F. Bukacek

Sulfur Recovery

Hays, H. L. and Barber, F. T. SULFUR RECOVERY FROM H2S. *Oil Gas J.*, 52, 218, 21, 22, 25 (1954) April 6.

Sulfur recovery practice of Phillips Petroleum Co. is discussed with regard to processes used, cost data, and operating problems.

D. M. Mason

Johnstone, H. F. (assigned to Texas Gulf Sulphur Co.) RECOVERY OF SULFUR DIOXIDE CONTAINED IN WASTE GASES. U. S. 2,676,090 (1954) April 20.

In the process for recovering SO_2 from waste gases by washing with ammonia water, an improved method for separation of SO_2 from the ammonia-ammonium sulfite solution is described. Acidification of the solution with sulfuric acid and steam stripping, each heretofore used as a separate process for SO_2 regeneration, are combined in a single operation. Advantages include reduction of the supply of both ammonia and sulfuric acid into the system, reduction of the amount of heat required as compared with steam stripping alone, increase in yield of SO_2 in relation to ammonium sulfate. D. M. Mason

6. PETROLEUM AND SYNTHETIC LIQUID FUELS

Bureau of Mines

SYNTHETIC LIQUID FUELS—1953—PART I.—OIL FROM COAL. U. S. Bur. Mines Rep. Invest. 5043 (11954) April.

During the year investigations at the Bruceton and Pittsburgh stations included development and trials of several Fischer-Tropsch iron catalysts, removal of CO_2 from synthesis gas, and separation and identification of F-T products. One-step high-pressure hydrogenation showed high yields on a lab-scale unit. Studies of molybdenum, nickel and iron hydrogenation catalysts gave favorable results. Gasification at the Morgantown station included 53 test runs on coals from West Va., Va., Wyo., Wash., and Pa. at atmospheric and at 450 psig pressures, as well as work on sulfur removal and methanation. At Gorgas underground gasification was shut down and flooded, but Alabama Power Co. has since test-drilled to outline the reacted area. At the Louisiana, Mo. plant vapor-phase hydrogenation runs were made on liquid-phase oils from Illinois No. 6, Pittsburgh and Velva (lignite) seams yielding 400,000 gal gasoline. Run No. 4 of the gas-synthesis plant was completed in Jan. (22,500 gal gasoline yield) and the plants were shut down and returned to the Army for disposal. O. P. Brysch

SYNTHETIC LIQUID FUELS—1953. PART II.—OIL FROM OIL SHALE. U.S. Bureau Mines Rep. Invest. 5044 (1954) April.

This report covers mining, retorting and refining investigations carried out by the Bureau in 1953. The gas-combustion process for retorting was further developed in pilot plant studies. The entrained-solids retorting process was also studied for the utilization of shale fines. The relations of operating variables to product yields were determined on bench scale. Results of laboratory research on refining and catalytic conversion of shale oils are also presented. Research was continued on the characterization of the organic matter (kerogen) in oil shale.

E. B. Shultz

Desulfurization

Duval, C. A. and Kalichevsky, V. A. TREATING GASOLINE BY DUALAYER PROCESS. *Oil Gas J.*, 49, 122-23, 50-51 (1954) April 12.

An improved process of the solutizer type for removal of mercaptans from gasoline is discussed. The concentrations of organic acid, which may be cresylic acid extracted from the petroleum fractions treated, and caustic, which preferably is potassium hydroxide, are maintained at higher levels than conventionally

maintained. The three-component system, icy water-potassium cresylate-potassium hydroxide, separates into two layers under these conditions. Only the layer rich in potassium cresylate is contacted with the gasoline, since this solution has a high capacity for mercaptans and hence only a realively small amount of solution is required. The solution is regenerated by diluting with water, boiling out the water and mercaptans with closed steam coils in a stripping tower, and contacting the solution with a concentrated potassium hydroxide solution.

D. M. Mason

Oosterhout, J. C. and Pingrey, G. D. (assigned to The Texas Co.) SWEETENING AND STABILIZING HYDROCARBON OILS. U.S. 2,674,566; 2,674,567 (1954) April 6.

Sweetening of hydrocarbon oils by addition of metal salts such as copper naphthenate is promoted by addition of mercapto-alkyl-benzimidazole. The gum-forming tendency of the organic metal salt may be inhibited by addition to the treating materials of an N-salicylalamino alkane, particularly a polysalicylalamino polyalkane. A further feature is the addition of a material, such as a para-phenylenediamine, which is adapted to stabilize the oil as regards oxidation or gum formation and also possesses a sweetening property. The process is essentially an additive treating process; the quantities of materials required are far less than the stoichiometric quantity based on the amount of mercaptan, and generally are less than 1/10 of the stoichiometric. Agitators or reaction vessels are not required. D. M. Mason

Directional Wells

Eastman, H. J. PRODUCING DIRECTIONALLY DRILLED WELLS. *World Oil*, 138, 230, 32, 34, 38, 40, 43 (1954) April.

Directionally drilled wells have certain advantages in the drilling and completion stage of operations, in that the equipment for several wells can be located adjacently, minimizing installation expenses. However, a survey of 1270 deviated wells indicate that the lifting costs for these wells averages between 8 and 10% higher than for a "straight" hole. B. E. Eakin

Pebble Heater Process

Bethea, C. F. (assigned to Phillips Petroleum Co.) PEBBLE HEATING APPARATUS FOR CARRYING OUT A PLURALITY OF PROCESSES CONCOMITANTLY. U. S. 2,676,909 (1954) April 27.

A design for a pebble heater that concomitantly cracks heavy tars and propane to lighter hydrocarbons while keeping the pebble surfaces free of carbon. G. V. Vosseller

Kilpatrick, M. O., Dean, L. E., Hall, D. S., Seed, K. W. NEW PEBBLE HEATER PROCESS. *Petroleum Refiner*, 33, 171-174 (1954) April.

The new Phillips Petroleum Company, pebble-heater cracking unit at Borger, Texas, is described and results of experimental operation presented. The process is similar in operation and equipment design to the TPC process developed by Socony Vacuum Company and Surface Combustion Corporation. Continuous in operation, ceramic pebbles are circulated through a heater in which the temperature level is raised by burning off coke deposits from the pebble surfaces and by the combustion of supplementary fuel. The heated pebbles are fed by gravity to the reactor located below the heater where hydrocarbon feed is contacted countercurrently and thermal cracking carried out. Cracked products are withdrawn and quenched at the reactor top while spent pebbles are withdrawn from the bottom and conveyed by pneumatic lift to the top of the heater. By employing high cracking temperatures (1600-1700°F.) and short residence times, high ethylene-acetylene yields are obtained from light hydrocarbon feeds. J. M. Reid

Shale Oil Refining

Berg, L., Mayfield, L. G., Saner, H. A. and Crecelius, R. L. CAT POLYFORMING OF SHALE OIL BETTER THAN CATALYTIC CRACKING. *Petroleum Eng.*, 26, C111-C115 (1954) April.

In an attempt to produce higher yields of a more stable gasoline from shale oil, catalytic polyforming over an aluminum silicate-catalyst was studied. Isobutylene, but not n-butane, when used as the added gas gave higher gasoline

yields than could be obtained by conventional catalytic cracking, and the maximum yields were found at lower temperatures and higher space velocities. The polyforming eliminated almost all color instability from the gasoline and had little or no effect on the octane number.

E. B. Shultz

Unifining

Grote, H. W., Watkins, C. H., Poll, H. F., and Hendricks, G. W. UNIFINING . . . A NEW PETROLEUM PROCESS. *Oil Gas J.*, 52, 211-16 (1954) April 19.

Unifining is a new refining process which permits economic improvement of product quality of a variety of refinery stocks. This improvement is obtained by hydrogenation over catalysts containing cobalt and molybdenum, resulting in the nearly complete removal of sulfur, nitrogen, and metals. In addition, when applied to cracked distillates, olefins are saturated and oxygen compounds are decomposed. The process is applicable to a wide range of distillate stocks from gasolines to gas oils and catalytic cycle stocks.

D. M. Mason

7. ANALYTICAL METHODS AND TESTS

Aromatic Spectrometry

Shively, J. H. and Morello, J. J. USING MASS SPECTROMETRY IN AROMATIC HYDROCARBON ANALYSIS. *Petroleum Proc.*, 9, 554-555 (1954) April.

An aromatic hydrocarbon analysis involving one distillation cut and mass spectrometer analysis. The distillation is set to separate the C_8 and lighter aromatics. A six by six matrix is set up involving benzene, toluene, ethylbenzene, xylene, cumene, and N-propylbenzene.

P. V. Burket

Coke Volatiles

Bispham, T. and Weston, F. R. THE NATURE OF THE VOLATILE MATTER IN COKE. *J. Inst. Fuel*, 27, 201-208 (1954) April.

In the determination of the volatile matter in coke by loss in weight upon heating, the authors present detailed evidence that most of the loss is due to evolution of water and oxides of carbon. These are a result of chemisorbed oxygen, or of products of decomposition of a complex of C, H and O formed after carbonization, chiefly during quenching and storage. Gas analyses of the volatiles distilled under vacuum at 965° C. from dried plant cokes made in horizontal, continuous vertical and intermittent vertical retorts, and coke ovens indicates that chiefly water and carbon dioxide are evolved up to 700° C., after which increasing amounts of carbon monoxide, hydrogen and methane are given off, in amounts which approach the composition of the "final" gas (or "true volatile matter") coming off the carbonizing plant charge. Thus, depending on the history of similar cokes after carbonization, a volatile content of 1% may vary from 1 to 5% in volatile therms. The results indicate that the nature of the volatile matter must be properly interpreted, and that revised methods are needed to show residual volatile.

O. P. Brysch

Fractionation Analysis

Podbielniak, W. J. MOVABLE THERMOCOUPLE FOR DETERMINING AND CONTROLLING THE LOCATION OF THE VAPOR CONDENSATION RING IN A FRACTIONATING COLUMN. U. S. 2,676,914 (1954) April 27.

In the analysis of volatile liquids and condensible vapors by low temperature fractional distillation, cut points are established more accurately by means of a thermocouple which may be placed successively at predetermined locations in the reflux section of the column and temperature recorded at each location. The lowest temperature so obtained at a given point in the distillation is at the boiling point of the reflux at its top-most boundary and hence is more nearly indicative of the composition of the distillate leaving the column than is the temperature indicated by a single thermocouple.

D. M. Mason

Gas Analysis

McDonald, F. S. and Kobe, K. A. GAS ANALYSIS BY THERMAL CONDUCTIVITY. *Oil Gas J.*, 52, 98, 101-03 (1954) March 29.

The design of a gas analyzing instrument of the thermal conductivity type using thermistor

elements rather than conventional metallic wire elements, is discussed. Construction details of an instrument and of operating conditions when applied to the analysis of a methane-isobutane system are described. D. M. Mason

H_2S Determination

Bethge, P. O. ON THE VOLUMETRIC DETERMINATION OF HYDROGEN SULFIDE AND SOLUBLE SULFIDES. *Anal. Chim. Acta*, 10, 310-311 (1954) April.

The volumetric determination of sulfides using potassium iodate as the oxidizing agent is briefly investigated. A method is given which makes it possible to oxidize sulfides quantitatively to the sulfate state, and it is shown that it is superior to methods employing potassium permanganate and sodium hypochlorite.
Author's Abstract

Oxygen Determination

Hoover, S. R., Jasewicz, L. and Porges, N. MEASUREMENT OF OXYGEN TRANSFER. *Instr. and Automation*, 27, 774-75 (1954) May.

Oxygen analyses of effluent gas from biochemical processes supplied with oxygen gives data on the oxygen uptake within the system. Use of a magnetic oxygen analyzer in studies of aerobic oxidation of dairy wastes is demonstrated. The rate of oxidation by the bacterial flora and the efficiency of O_2 transfer to the organisms are readily determined. The utility of such instrumentation in research and operation of sewage, industrial-waste, and fermentation plants is discussed. Authors' Abstract

Van Straten, H. A. THE DETERMINATION OF OXYGEN IN GASES BY THE MANGANOUS HYDROXIDE METHOD. *Anal. Chim. Acta*, 10, 243-255 (1954) March.

The present article describes an investigation into the manganous hydroxide method for determining low concentrations of oxygen in gases. It is shown that deaeration of the reagents in vacuo at elevated temperatures, the concentration of the manganous hydroxide, which has to be such as to produce a finely distributed precipitate, and the reaction time are the factors that determine the correctness of the analysis. Neither unsaturated hydrocarbons, including acetylene, nor carbon monoxide interfere with the determination. For oxygen concentrations of from 0.1 to 4% by volume, the reproducibility is equal to 3.6% of the oxygen content. With concentrations lower than 0.1% by volume of oxygen, the reproducibility is equal to 0.004% by volume of oxygen. A detailed description of the method is given in the appendix. Author's Abstract

Water in Gas

Deaton, W. M. AN INSTRUMENT FOR THE MEASUREMENT OF WATER VAPOR IN NATURAL GAS. Proc. Gas Hydrate Control Conference, Univ. Oklahoma, 17-24 (1953) May 5-6.

A description of the U. S. Bureau of Mines water-vapor dew point recorder.
R. F. Bukacek

8. GENERAL AND PHYSICAL CHEMISTRY

Conductivities of Gases

Thomas, L. B. and Golike, R. C. A COMPARATIVE STUDY OF ACCOMMODATION COEFFICIENTS BY THE TEMPERATURE JUMP AND LOW-PRESSURE METHODS AND THERMAL CONDUCTIVITIES OF He, Ne, AND CO_2. *J. Chem. Phys.*, 22, 300-305 (1954) February.

The temperature jump and low pressure methods are used to determine the accommodation coefficients of He, Ne, and CO_2 on platinum under conditions as closely identical as compatible with the methods. Agreement is very close for He and for CO_2, giving values centering about 0.176 for He and 0.78 for CO_2. For Ne the results are ambiguous, giving good agreement with one sequence of preparation and giving temperature jump values 25 percent low with another. Variability is correlated with preparation history and variability with time is noted by both methods. Thermal conductivity values of He, Ne, and CO_2 are given and compared briefly with values in the literature.
Authors' Abstract

Conductivity of Ice

Coles, W. D. EXPERIMENTAL DETERMINATION OF THERMAL CONDUCTIVITY

OF LOW-DENSITY ICE. Nat. Adv. Comm. Aeron. Techn. Note 3143 (1954) March.

The thermal conductivity of ice was measured as a function of density and method of formation. The cold plate method was used for the experimental measurements. Ice was formed on the cold plate by condensation from air at various gas velocities and pressures. The results show good agreement with the equations for the thermal conductivity of packed snow as a function of snow density. Data on mass transfer from ice surfaces were also reported.

R. E. Peck

Cryogenic Equipment

Rasor, N. S. SIMPLE EQUIPMENT AND TECHNIQUES FOR A SMALL CRYOGENICS LABORATORY. *Rev. Sci. Instruments* 25, 311-318 (1954) April.

Accessories for a Collins liquefier and a commercial liquid-helium storage container are described. Techniques used for reaching and measuring intermediate temperatures are outlined, along with a description of two portable cryostats. A small mica and Pyrex platinum resistance thermometer has been developed, and its relatively simple fabrication is described.

D. C. Gami

Flame Profiles

Fristrom, R. M., Avery, W. H., Prescott, R. and Mattuck, A. FLAME ZONE STUDIES BY THE PARTICLE TRACK TECHNIQUE. I. APPARATUS AND TECHNIQUE. *J. Chem. Phys.*, 22, 106-109 (1954) January.

A discussion is given of flame temperature profiles of laminar premixed Bunsen flames derived by the particle track method. The apparatus required for the study is described. A critical discussion of the technique and the flame model is presented. This method allows the derivation of a temperature profile for a flame front which is accurate in temperature and relative position to a few percent depending on the pressure. The profile should provide description of translational temperature within the flame front. The singular regions of the flame tip and burner lip are excluded from this discussion.

Authors' Abstract

Gas Equilibria

Corrigan, T. E. CHEMICAL ENGINEERING FUNDAMENTALS. CHEMICAL EQUILIBRIUM—II. *Chem. Engrg.*, 61, 212, 214, 216, 218, 220 (1954) April.

In this article calculations of equilibrium constants and fugacity for ideal and non-ideal gases are shown.

D. C. Gami

Gas Permeability

Brubaker, D. W. and Kammermeyer, K. SEPARATION OF GASES BY PLASTIC MEMBRANES. *Ind. Eng. Chem.* 46, 733-739 (1954) April.

The present theory is reviewed and data are presented for mixtures of He, H_2, CO_2, O_2, N_2, NH_3, and SO_2. Permeability increased with increasing temperature. Separation by such a technique cannot economically compete today, but the present plastic film is produced with the intent of reducing the permeability—evidently this could be reversed to some degree.

W. W. Clauson

Graphite Structure

Matuyama, E. PYROLYSIS OF GRAPHITIC ACID. *J. Phys. Chem.*, 58, 215-219 (1954) March.

The pyrolysis of various graphitic acids were followed by obtaining X-ray diffraction patterns at their various temperatures of carbonization. Five bands were obtained at room temperatures while at 1800° C., where it was completely graphitized, there were only four bands.

S. Mori

Infrared Absorption

Chisholm, D. A. and Welsh, H. L. INDUCED INFRARED ABSORPTION IN HYDROGEN AND HYDROGEN-FOREIGN GAS MIXTURES AT PRESSURES UP TO 1500 ATMOSPHERES. *Canad. J. Physics*, 32, 291-311 (1954) April.

Pressures of up to 1500 atmospheres and temperatures of up to 376° K are used to study the induced infrared absorption bands of hydrogen. The profile, of the spectra, is shown to depend on the nature of the perturbing gas, on the temperature, and here, on the density. The max. density reached of the gases, was usually of the order of the corresponding liquids at their normal boiling points. The Q branch is shown to be split into 3 components and a proposal for their behavior is put forth.

R. R. Amrine

Refractive Index

Bricout, P. A. REFRACTIVE INDEX NOMOGRAM FOR DRY AND HUMID AIR. *Canadian J. Physics*, 32, 243-245 (1954) March.

The refractive index of humid air is the sum of unity plus a term depending on pressure and temperature (dry air refractivity). Two alignment nomograms give the values of both refractivities within a range of 300 to 1100 mb. for pressure, +45° C. to —40° C. for temperature, 0 to 100% for relative humidity. Relative errors do not exceed 1% of (n — 1).

Author's Abstract

Sulfur Properties

Guthrie, G. B., Jr., Scott, D. W. and Waddington, G. THERMODYNAMIC FUNCTIONS AND HEAT OF FORMATION OF S_8(GAS). *J. Amer. Chem. Soc.*, 76, 1488-93 (1954) March 20.

Values of the free energy function, heat control, entropy, and specific heat of S_8(gas) at temperatures up to 1000° K. were calculated from spectroscopic and molecular structure data. Values of the heat of formation of S_8(gas) from rhombic sulfur were computed from published experimental data. D. M. Mason

Viscosity

Westmoreland, J. C. GAS VISCOSITY RESPONSIVE APPARATUS. U. S. 2,674,118 (1954) April 6.

An apparatus for measuring the viscosity of a gas was described. Poiseuille's equation formed the mathematical basis for calculation. Seven claims cover the maintenance of a small constant pressure drop and its measurement along with the measurement of a small flow rate. W. W. Clauson

Whalley, E. THE VISCOSITY OF GASES AND THE THEORY OF CORRESPONDING STATES. *Canad. J. Chem.*, 32, 485-91 (1954) May.

The viscosity of gases is examined using the theory of corresponding states. The curve of reduced viscosity plotted against reduced temperature is compared with the theoretical curves obtained for several intermolecular potentials. The approximate Sutherland equation gives the best fit and it is suggested that this be used to extrapolate viscosities to high temperatures where experimental data are not available. The reduced viscosity—reduced temperature plot can be used for estimating the viscosities of simple gases from critical data, or critical data from the viscosities.

Author's Abstract

9. ORGANIC CHEMISTRY

Acetylene Chemicals

Lynn, R. E., Jr. and Kobe, K. A. VINYL CHLORIDE FROM DILUTE ACETYLENE GASES. *Ind. Eng. Chem.*, 46, 633-643 (1954) April.

The results of bench-scale and small pilot plant investigations of a vinyl chloride synthesis process are described. Vinyl-chloride is produced by the reaction of chlorine gas directly with the raw acetylene-bearing gases from any of the available commercial acetylene syntheses (from hydrocarbons) processes taking advantage of the high hydrogen content common to each process. J. M. Reid

Cyanide Synthesis

Daniels, J. PROCESS FOR RAPIDLY AND CONTINUOUSLY PERFORMING A HIGH TEMPERATURE ENDOTHERMIC REACTION BETWEEN A SOLID AND A GASEOUS REACTANT. U. S. 2,675,295 (1954) April 13.

The patent refers to a method of producing cyanides by high temperature contacting of finely divided solid carbonates and carbon in suspension with nitrogen and other carrier gas, the endothermic heat of reaction being supplied by continuous combustion of carbon with oxygen. C. G. von Fredersdorff

Sherwood, P. W. HYDROGEN CYANIDE. PART I, HCN AND ACRYLONITRILE; *Petroleum Proc.*, 9, 384-389 (1954) March.

Hydrogen cyanide, traditionally produced by recovery from coke-oven gas, has become a primary petrochemical in the last five years with production well above 200 million pounds annually. Practically all of the new capacity is

based on the partial oxidation of ammonia in the presence of methane. The largest share of the output is being consumed in the production of acrylonitrile, an intermediate in manufacture of synthetic fibers and rubber, plastics, and soil conditioners. Almost all of the new acrylonitrile plant capacity employs the combination of acetylene and hydrogen cyanide in the presence of a catalyst. E. B. Shultz

Sherwood, P. W. HYDROGEN CYANIDE. PART II, ACRYLATES, METHACRYLATES AND ADIPONITRILE. *Petroleum Proc.*, 9, 548-53 (1954) April.

A description is given of manufacturing processes which are important consumers of HCN in the synthesis of acrylates, methacrylates and adiponitrile, together with a discussion of the petrochemical uses of such products in plastics, fibers and coatings. D. J. Dennison

Petrochemical Activity

Brien, E. B. PETROCHEMICALS IN HIGH GEAR. *Petroleum Eng.*, 26, C5-C12 (1954) April.

A survey of the present status of the petrochemical industry reveals an unpredicted rate of expansion indicated by volume of production and capital investment. It is expected that the high rate of expansion will continue for several years but will level off as competition is more strongly felt. There are indications that some over production will exist in some volume products made by a large number of companies. J. M. Reid

10. CHEMICAL ENGINEERING

Fluid Flow

Gold, H. and Otto, E. W. AN ANALYTICAL AND EXPERIMENTAL STUDY OF THE TRANSIENT RESPONSE OF A PRESSURE-REGULATING RELIEF VALVE IN A HYDRAULIC CIRCUIT. Nat. Adv. Comm. Aeron. Techn. Note 3102 (1954) March.

The transient response of the pressure-regulating relief valve in a hydraulic circuit is analyzed by means of an electrical analogy of the hydraulic circuit. Measurements of the transient response of a hydraulic relief valve are presented and are compared with responses calculated from the differential equation of the equivalent electric network. The comparison of experimental and analytical responses shows that the response of the relief valve can be adequately predicted by means of the equivalent network. The analysis of a typical relief valve by means of the equivalent network indicates that viscous damping is negligible and that the principal damping is derived from the flow resistance of the various elements of the hydraulic circuit. An expression is analytically developed that yields directly the area-lift relation for the relief valve for stable valve operation over wide flow-rate ranges. Authors' Abstract

Fractionation

Young, R. M. FRACTIONATING-ABSORPTION TRAY DESIGN. *Oil Gas J.*, 52, 152-154 (1954) April 26.

Bubble-cap columns have been extensively used in the petroleum industry on account of their ability to handle a wide range of feed stocks and vapor-liquid loads at a comparatively low cost. Test results obtained by the C. F. Braun and Co. with a 66" x 18' tower have been discussed according to the following performance factors: pulsation, dumping, coning, blowing, entrainment, and flooding. Causes of these troubles are given and preventive measures suggested. Solutions for four sample design problems are shown in tabular form. S. Hu

Materials Handling

Chapman, F. MATERIALS HANDLING IN THE GAS INDUSTRY. *Gas*, 30, 59-65, 72, 76, 78, 82-84 (1954) April.

This article considers in detail the material handling problems of the gas industry, their solutions by different companies and the importance of a sound philosophy of the storing and handling function. R. F. Bukacek

Strube, H. L. CONVEYORS AND ELEVATORS. *Chem. Eng.* 61, 195-210 (1954) April.

This article describes the salient features of continuous bulk handling equipment and provides diagrams, graphs and tables to aid in the selection of the proper type of equipment for any particular bulk handling job. A. J. Tulis

Pressure Vessels

Finlay, B. A. THE THEORY OF HIGH PRESSURE VESSEL DESIGN. *Chem. Process Eng.*, 35, 147-152 (1954) May.

A summary is presented of various formula for calculating the thickness of thin-wall, thick-wall and multi-shell vessels, including mathematical derivations and a consideration of theories of failure and methods of construction.

C. G. von Fredersdorff

Steam Generation

Durham, E. STEAM GENERATION. *Chem. Eng. Costs Quarterly*, 4, 41-63 (1954) April.

This article presents many illustrations of the equipment incorporated in steam generation plus many tables of information needed in calculating steam generating costs. As is emphasized fuel accounts for about three-quarters (¾) of the total cost of steam whereas labor, management, taxes, insurance, plant operation, etc., determine the remainder of the operating costs of the steam plant. An example of determining the cost of a hypothetical steam plant is presented which may be used for establishing the cost of steam.

S. Volchko

11. PROCESS EQUIPMENT AND INSTRUMENTATION

Computer

LOW-COST DIGITAL COMPUTER. *Mech. Eng.*, 76, 268-269 (1954) March.

A new tool for the high-speed handling of computations is available to industry in the form of the ALWAC, a general-purpose electronic digital computer. The machine features a 2048-word magnetic drum memory which stores the operation commands (instructions) and the numbers used in the computations. Data input, and calculation output, is by means of an electric typewriter. Some of the jobs which it is capable of handling include: inventory and production control, cost accounting, data reduction and repetitive calculations, preparing manufacturing schedules to meet frequently changing production schedules, and controlling machine-tool operations.

B. E. Eakin

Flow Meter

Garwin, L. and Landes, S. H. PIPE TEE FLUID FLOWMETER. *Ind. Eng. Chem.*, 46, 665-669 (1954) April.

A flowmeter is described, in which standard screwed-pipe tees and fittings are used to contruct the impact and the velocity sections. Pressures measured at these sections are related to velocity flow and volume flow for several pipe sizes, and these factors are tabulated.

W. G. Bair

Fractionation Control

Bergman, D. J. INSTRUMENTATION FOR PRECISE FRACTIONATION OF BENZENE AND TOLUENE. *Oil Gas J.*, 52, 127-28, 30 (1954) April 12.

A practical discussion on the proper choice of reflux controlling devices for the precise fractionation of benzene from toluene and xylene. The methods considered employ either a differential temperature-measuring element or a vapor-pressure-measuring element. Depending on the operating conditions, the controller may best be located above or below the feed plate, but should never be positioned on the top plate. Illustrative sketches and plant data are given.

S. Hu

Gas Detectors

Gleim, E. J. PORTABLE METHANE-DETECTING APPLIANCES APPROVED UNDER UNITED STATES BUREAU OF MINES STANDARD. U. S. Bur. Mines Rep. Invest. 5056 (1954) April.

This article gives the standard for approval of methane detectors and lists twelve approved detectors. A description and photograph of the four actively marketed detectors is given.

E. Mann

Gray, J. W. and Johnson, T. F. GAS DETECTOR. U. S. 2,673,339 (1954) March 23.

An instrument for detecting the presence of an explosive atmosphere (as in mines) is described. It comprises a cylinder with means for periodically reciprocating a piston to draw in a sample of gas and with means for creating a spark or with other ignition device within the cylinder so that an explosive mixture of gas will produce an explosion operating a detecting device.

D. M. Mason

Manometers

MacMillan, F. A. LIQUID MANOMETERS WITH HIGH SENSITIVITY AND SMALL TIME-LOG. Nat. Adv. Comm. Aeron. N30309; (Aeron. Resch. Counc. 16,091); T.P.404; F.M. 1941 (1953) August 14.

Some problems in the design of a manometer with small time lag and small rate of change of zero reading are discussed, and some general principles of design are derived. This article refers specifically to the very small differential measurements encountered in wind tunnel work.

R. F. Bukacek

Molecular Still

Burrows, G. MOLECULAR DISTILLATION. *Chem. and Process Eng.* (British), 35, 91-93, (1954) March.

This article summarizes the author's earlier paper, "Some Aspects of Molecular Distillation". Brief descriptions are given of different types of stills. A devolatiliser has been described in British Patent No. 695,560 and combined fractionating and centrifugal stills have been described in British Patent No. 644,621 and U. S. Patent No. 2,606,146. Some applications of molecular distillation are given.

E. Mann

Photography

Packard, R. J. TECHNICAL PHOTOGRAPHY. PART II.—PHOTOGRAPHIC OBSERVATION. *Laboratory Practice*, 3, 151-55, 72 (1954) April.

The article is a technical review of the many applications of photography. Some uses of photography on pyrometry are presented in details. The use of infrared, x-ray and oscillography methods is generally described.

S. Sensi

Pipe Maintenance

Pinske, R. J. PIPING MAINTENANCE PRACTICES SURVEYED. *Heating, Piping and Air Conditioning*, 26, 73-78 (1954) April.

The article emphasizes the cost of neglecting pipe maintenance and gives suggestions for setting up a realistic maintenance schedule.

W. G. Bair

12. MATERIALS OF CONSTRUCTION

Coatings

Grove, M. B. INTERNAL COATING OF PIPE IN PLACE. *Corrosion*, 10, 142-46 (1954) May.

This article covers experience gained from three applications of internal plastic lining. Specifically, the procedures and results of these applications are given for lining aluminum pipe, new steel pipe and badly corroded steel pipe. A typical coating job in a line in service is described. In the crude oil pipe line industry, this protective technique is particularly applicable to sour-crude gathering and lateral line service where in many cases, by comparison, an inhibitor or even a scraper program can not be justified economically.

S. Volchko

Asbestos-Cement Pipe

Romanoff, M. and Denison, I. A. EFFECT OF EXPOSURE TO SOILS ON THE PROPERTIES OF ASBESTOS-CEMENT PIPE. *Corrosion*, 10, 169-79 (1954) May.

A detailed presentation of the tests conducted on asbestos-cement pipe to determine the effect of soils and exposure on the physical properties of the pipe. The tests included exposures for up to 13 years in 15 different soil types. In general the curing of the pipe continues for several years underground so the bursting strength may actually increase for a time. Following the cure period the pipe loses strength but never falls below Federal specifications for the type of pipe. The tests were conducted by the National Bureau of Standards.

W. G. Bair

Insulated Joints

Peabody, A. W. EIGHT USES FOR INSULATING JOINTS. *Gas Age*, 113, 25-30, 75-81 (1954) May 6.

In distribution mains, uses of insulating joints are: to separate dissimilar metals; to separate old from new pipe; to separate coated from bare pipe; to expedite testing on cathodically protected systems; and to minimize effects of stray current electrolysis. On distribution services: To prevent corrosion caused by electrical con-

tact with dissimilar metals; to help control electrolysis where stray d.c. current is a factor; and in conjunction with application of cathodic protection. A general discussion of the methods of installing insulating joints is given for each of the applications suggested.

B. E. Eakin

Insulation Thickness

HEAT-LOSS GRAPH AIDS IN SPECIFYING MOST ECONOMICAL INSULATION THICKNESS. *Ind. Heating*, 21, 563, 64, 66 (1954) March.

This article presents a nomograph for determining approximate heat losses through mineral wool insulation, including the outside surface film coefficient, and converting this to an annual cost of heat lost per square foot exposed area for continuous operation and a given unit fuel cost. This type of presentation will save the design or plant engineer considerable time and effort in determining optimum insulation thickness for a job given insulation and fuel costs.

R. T. Ellington

Pipe Flanges

Tube Turns, Inc. RATINGS OF AMERICAN STANDARD STEEL PIPE FLANGES. Piping Eng. 6.02 (Tube Turns, Inc.), 1-39 (1953) November.

A new edition of the "American Standard on Steel Flanged Fittings and Flanges" has just been approved and put into effect under the designation ASA B16.5-1053, replacing ASA B16.e. It presents the culmination of the effort begun in 1941 to bring flange ratings in line with modern concepts of flange design. It differs from prior issues in the following significant respects: 1) A clearly defined rating basis has been established. 2) Ratings are extended to all commonly used alloy steels. 3) All possible varieties of gaskets and facings are included. 4) The range of flange types available has been enlarged by the addition of socket welding flanges and the reinstatement of slip-on flanges of the 400 lb., 600 lb., and 900 lb. pressure classes. 5) The number of pressure classes has grown from an original five to a total of seven and include the following: 150 lb., 300 lb., 400 lb., 600 lb., 900 lb., 1500 lb., and 2500 lb. 6) Minor adjustments of bore dimensions of slip-on and lap joint flanges were made. 7) Stud bolt lengths are included. The new standard made no major changes in the flange dimensions; hence the dimensional information given in "Piping Engineering" Paper 6.01 (Tube Turns, Inc.) remains essentially correct; however, the pressure-temperature ratings underwent considerable modification and expansion, so that the rating tables have become outdated. The new ratings, including all pertinent notes, are given in Section B of this paper. Their basis is explained in the light of present-day flange design methods in Section A. Their antecedents are traced from the original 1927 tentative standards to the present issue in Section C.

H. C. Owen

Refractory Slagging

Dixon, D. WASTAGE OF REFRACTORIES BY SLAG ATTACK CAUSES AND EFFECTS. *Chem. and Process Eng.* (British), 35, 121-123 (1954) April.

Relating primarily to aluminous fireclay or high alumina refractories a discussion is presented of the mechanism of wear and wastage of refractories in service due to slag attack and spalling. Different forms of slag attack and spalling are illustrated with sketches; and the action of corrosion, erosion, penetration and solution is treated in detail. No reliable guide exists for refractory users in respect to slag resistance in existing refractory specifications and test data, because of the difficulty of reproducing exact service conditions.

E. J. Pyrcioch

Tank Welding

Feely, F. J. and Northup, M. S. WHY STORAGE TANKS FAIL. *Oil Gas J.*, 52, 73-78 (1954) February 1.

The present stage of an investigation upon the failure of storage tanks, conducted by an A.P.I. Committee, shows that the main cause for large-size tank failure is due to poor welding standards. A second factor is considered the insufficient notch toughness which occurs in welding plates of different thickness. Furthermore, the inspection means were inadequate to detect the latent defects, while the probe samples were practically useless for evaluating the welds.

S. Sensi

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